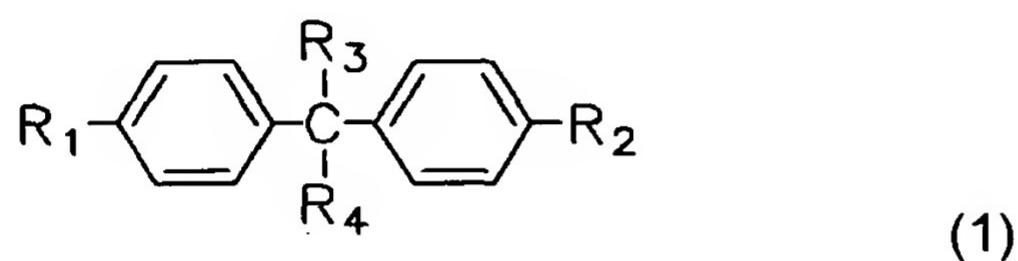


## CLAIMS

What is claimed is:

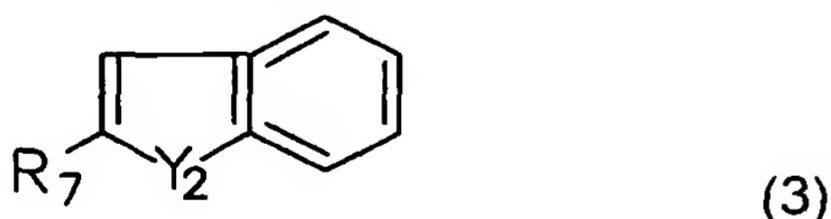
1. A non-aqueous electrolyte of a lithium secondary battery, comprising:  
a lithium salt;  
an organic solvent; and  
at least one additive compound selected from the group consisting of compounds represented by the following formulas (1) to (6):



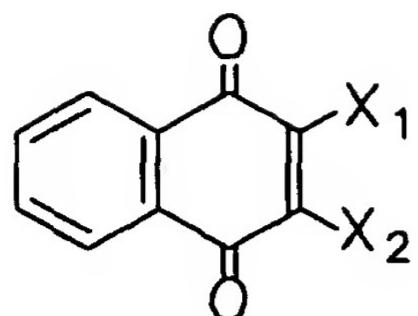
where R<sub>1</sub> and R<sub>2</sub> are independently selected from the group consisting of a hydroxy, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy substituted with a halogen and a C<sub>2</sub> to C<sub>6</sub> alkenyl substituted with a halogen; and R<sub>3</sub> and R<sub>4</sub> are independently selected from the group consisting of a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and a methyl;



where Y<sub>1</sub> is selected from the group consisting of O, NR (where R is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and 1-phenylsulfonyl), and S, and R<sub>5</sub> and R<sub>6</sub> are independently selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and an acetyl, and a methyl;

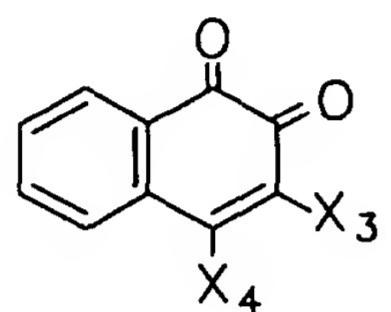


where Y<sub>2</sub> is selected from the group consisting of O, N, and S, and R<sub>7</sub> is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, and a C<sub>6</sub> to C<sub>12</sub> aryl;



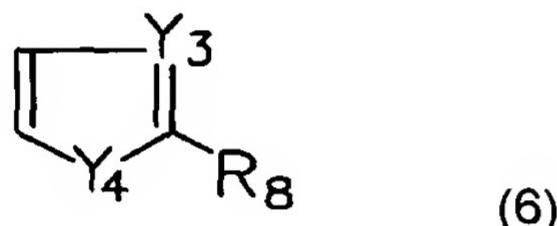
(4)

where  $X_1$  and  $X_2$  are independently selected from the group consisting of hydrogen and a halogen selected from the group consisting of F, Cl, and Br;



(5)

where  $X_3$  and  $X_4$  are independently selected from the group consisting of hydrogen and a halogen selected from the group consisting of F, Cl, and Br; and



(6)

where  $Y_3$  is selected from the group consisting of N, O, and S, and  $N, Y_4$  is NR' (where R' is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, O, S, and NH, and  $R_8$  is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and an acetyl).

2. The non-aqueous electrolyte of a lithium secondary battery according to claim 1, wherein the additive compounds are at least one selected from the group consisting of bisphenol A, 2,5-dimethylfuran, 2-acetyl furan, 2-acetyl-5-methylfuran, 1-(phenylsulfonyl) pyrrole, 2,3-benzofuran, 2-butylbenzofuran, thianaphthene, 2,3-dichloro-1,4-naphthoquinone, 1,2-naphthoquinone, 2,3-dibromo-1,4-naphthoquinone, 3-bromo-1,2-naphthoquinone, and 2-methyl imidazole.

3. The non-aqueous electrolyte of a lithium secondary battery according to claim 1, wherein the additive compound is used substantially in an amount of 0.01 to 10 wt%, based on a total weight of electrolyte.

4. The non-aqueous electrolyte of a lithium secondary battery according to claim 3, wherein the additive compound is used substantially in an amount of 0.01 to 5 wt%, based on a total weight of electrolyte.

5. The non-aqueous electrolyte of a lithium secondary battery according to claim 4, wherein the additive compound is used substantially in an amount of 0.01 to 1 wt%, based on a total weight of electrolyte.

6. The non-aqueous electrolyte of a lithium secondary battery according to claim 5, wherein the additive compound is used substantially in an amount of 0.01 to 0.5 wt%, based on a total weight of electrolyte.

7. The non-aqueous electrolyte of a lithium secondary battery according to claim 1, wherein the additive compound forms a passivation layer on a surface of a positive electrode.

8. The non-aqueous electrolyte of a lithium secondary battery according to claim 1, wherein the lithium salt is at least one selected from the group consisting of LiPF<sub>6</sub>, LiBF<sub>4</sub>, LiSbF<sub>6</sub>, LiAsF<sub>6</sub>, LiClO<sub>4</sub>, LiCF<sub>3</sub>SO<sub>3</sub>, Li(CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N, LiC<sub>4</sub>F<sub>9</sub>SO<sub>3</sub>, LiSbF<sub>6</sub>, LiAlO<sub>4</sub>, LiAlCl<sub>4</sub>, LiN(C<sub>x</sub>F<sub>2x+1</sub>SO<sub>2</sub>)(C<sub>y</sub>F<sub>2y+1</sub>SO<sub>2</sub>) (wherein x and y are natural numbers), LiCl, and LiI.

9. The non-aqueous electrolyte of a lithium secondary battery according to claim 8, wherein the lithium salt is used substantially at a concentration in the range of 0.6 to 2.0 M.

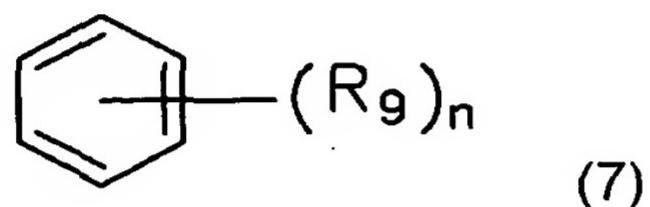
10. The non-aqueous electrolyte of a lithium secondary battery according to claim 1, wherein the non-aqueous organic solvent is at least one selected from the group consisting of a carbonate, an ester, an ether, and a ketone.

11. The non-aqueous electrolyte of a lithium secondary battery according to claim 10, wherein the carbonate is selected from the group consisting of dimethyl carbonate (DMC), diethyl carbonate (DEC), dipropyl carbonate (DPC), methylpropyl carbonate (MPC), ethylpropyl carbonate (EPC), methylethyl carbonate (MEC), ethylene carbonate (EC), propylene carbonate (PC), and butylene carbonate (BC).

12. The non-aqueous electrolyte of a lithium secondary battery according to claim 10, wherein the carbonate is a mixed solvent of a cyclic carbonate and a chain carbonate.

13. The non-aqueous electrolyte of a lithium secondary battery according to claim 1, wherein the organic solvent comprises a mixed solvent of a carbonate solvent and an aromatic hydrocarbon solvent.

14. The non-aqueous electrolyte of a lithium secondary battery according to claim 13, wherein the aromatic hydrocarbon solvent is a compound of Formula (7):



where  $R_9$  is selected from a group consisting of a halogen, and a  $C_1$  to  $C_{10}$  alkyl, and  $n$  is an integer of 1 to 6.

15. The non-aqueous electrolyte of a lithium secondary battery according to claim 12, wherein the aromatic hydrocarbon solvent is at least one selected from the group consisting of benzene, fluorobenzene, toluene, trifluorotoluene, xylene, and mixtures thereof.

16. The non-aqueous electrolyte of a lithium secondary battery according to claim 12, wherein the carbonate solvent and the aromatic hydrocarbon solvent are mixed in a volume ratio of 1:1 to 30:1.

17. The non-aqueous electrolyte of a lithium secondary battery according to claim 1, wherein the electrolyte further comprises an organic sulfone-based compound.

18. The non-aqueous electrolyte of a lithium secondary battery according to claim 17, wherein the organic sulfone-based compound is represented by the following formula (8):



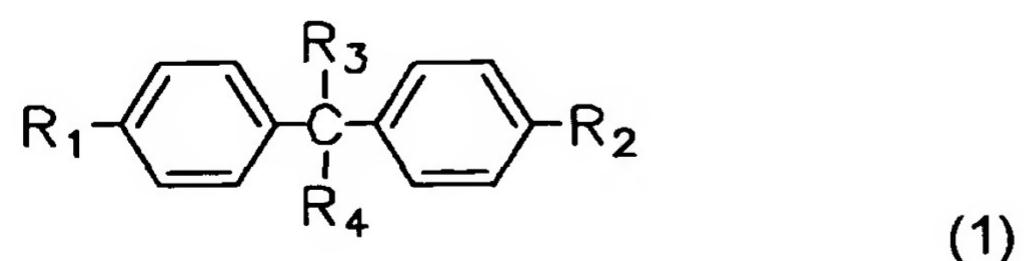
where R<sub>10</sub> and R<sub>11</sub> are independently selected from the group consisting of a primary alkyl group, a secondary alkyl group, a tertiary alkyl group, an alkenyl group, a cycloalkyl an aryl group, and a C<sub>1</sub> to C<sub>4</sub> alkyl, a C<sub>2</sub> to C<sub>4</sub> alkenyl, a C<sub>3</sub> to C<sub>6</sub> cylcoalkyl and a C<sub>6</sub> to C<sub>14</sub> aryl, or R<sub>10</sub> and R<sub>11</sub> are bound together to form a cyclic ring.

19. The non-aqueous electrolyte for a lithium secondary battery according to claim 18, wherein either of R<sub>10</sub> or R<sub>11</sub> is substantially vinyl.

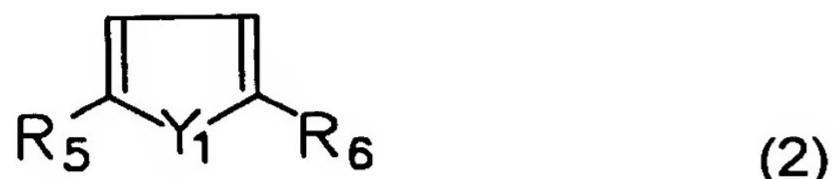
20. The non-aqueous electrolyte for a lithium secondary battery according to claim 17, wherein the organic sulfone-based compound is used substantially in an amount of 0.01 to 5 wt% based on a total weight of electrolyte.

21. A non-aqueous electrolyte of a lithium secondary battery, comprising:  
a lithium salt; an organic solvent; and at least one additive compound selected from the group consisting of bisphenol A, 2,5-dimethylfuran, 2-butylbenzofuran, thianaphthene, and 2,3-dichloro-1,4-naphthoquinone.

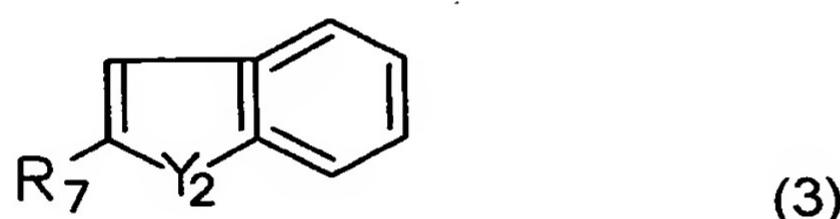
22. A lithium secondary battery comprising:  
a positive electrode including one of a material that reversibly intercalates/deintercalates lithium ions, and a material that reversibly forms a lithium-containing compound as a positive active material;  
a negative electrode including one of a lithium metal, a lithium-containing alloy, and a material that reversibly intercalates/deintercalates the lithium ions; and  
a non-aqueous electrolyte wherein the non-aqueous electrolyte comprises:  
a lithium salt;  
an organic solvent; and  
at least one additive compound selected from the group consisting of compounds represented by the following formulas (1) to (6):



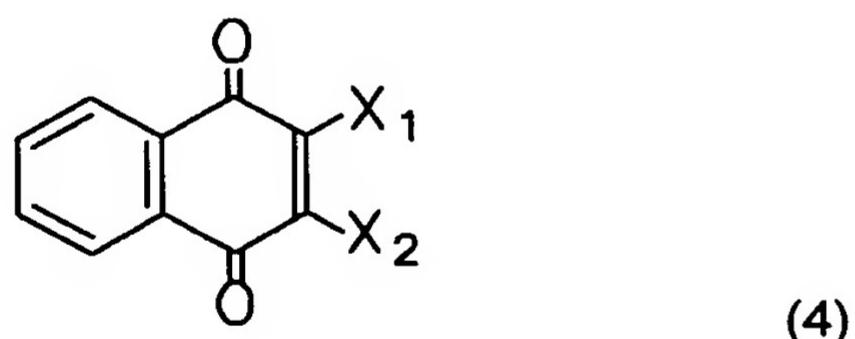
where R<sub>1</sub> and R<sub>2</sub> are independently selected from the group consisting of a hydroxy, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy substituted with a halogen, a C<sub>1</sub> to C<sub>4</sub> alkyl, a C<sub>2</sub> to C<sub>4</sub> alkenyl, a C<sub>6</sub> to C<sub>14</sub> aryl, and a C<sub>3</sub> to C<sub>6</sub> cycloalkyl, a halogen-substituted alkyl group, an alkenyl group, an aryl group, and a cycloalkyl group and a C<sub>2</sub> to C<sub>6</sub> alkenyl substituted with a halogen, and R<sub>3</sub> and R<sub>4</sub> are independently selected from the group consisting of a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and a methyl;



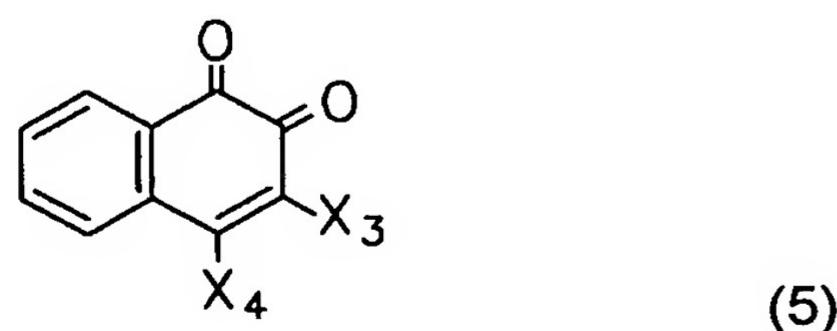
where Y<sub>1</sub> is selected from the group consisting of O, NR (where R is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>6</sub> to C<sub>12</sub> aryl, 1-phenylsulfonyl), and S, and R<sub>5</sub> and R<sub>6</sub> are independently selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>6</sub> to C<sub>12</sub> aryl, an acetyl, and a methyl;



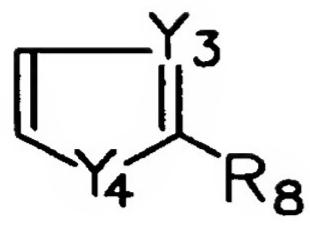
where Y<sub>2</sub> is selected from the group consisting of O, N, and S, and R<sub>7</sub> is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, and a C<sub>6</sub> to C<sub>12</sub> aryl;



where X<sub>1</sub> and X<sub>2</sub> are independently selected from the group consisting of hydrogen and a halogen selected from the group consisting of F, Cl, and Br ;



where X<sub>3</sub> and X<sub>4</sub> are independently selected from the group consisting of hydrogen and a halogen selected from the group consisting of F, Cl, and Br ; and



where  $Y_3$  is selected from the group consisting of N, O, and S,  $Y_4$  is NR' (where R' is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl), O, S, and NH, and R<sub>8</sub> is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and an acetyl.

23. The lithium secondary battery according to claim 22, wherein the positive electrode includes one of a lithium-nickel-based and a lithium-nickel-manganese-based oxide.

24. The lithium secondary battery according to claim 22, wherein the electrolyte comprises additive compounds selected from the group consisting of bisphenol A, 2,5-dimethylfuran, 2-acetyl furan, 2-acetyl-5-methylfuran, 1-(phenylsulfonyl) pyrrole, 2,3-benzofuran, 2-butylbenzofuran, thianaphthene, 2,3-dichloro-1,4-naphthoquinone, 1,2-naphthoquinone, 2,3-dibromo-1,4-naphthoquinone, 3-bromo-1,2-naphthoquinone, 2-methyl imidazole, and mixtures thereof.

25. The lithium secondary battery according to claim 22, wherein the electrolyte comprises the additive compound in substantially an amount of 0.01 to 10 wt% based on a total weight of electrolyte.

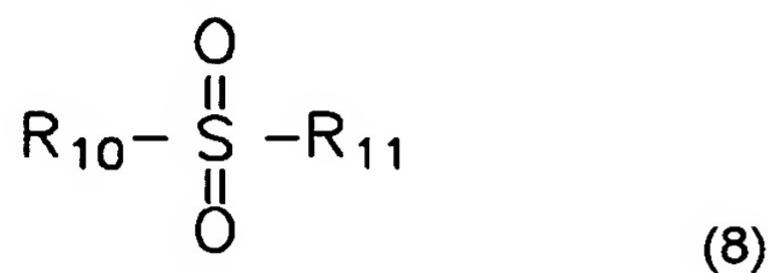
26. The lithium secondary battery according to claim 22, wherein the electrolyte comprises the additive compound in substantially an amount of 0.01 to 5 wt% based on a total weight of electrolyte.

27. The lithium secondary battery according to claim 22, wherein the electrolyte comprises a lithium salt selected from the group consisting of LiPF<sub>6</sub>, LiBF<sub>4</sub>, LiSbF<sub>6</sub>, LiAsF<sub>6</sub>, LiClO<sub>4</sub>, LiCF<sub>3</sub>SO<sub>3</sub>, Li(CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>N, LiC<sub>4</sub>F<sub>9</sub>SO<sub>3</sub>, LiSbF<sub>6</sub>, LiAlO<sub>4</sub>, LiAlCl<sub>4</sub>, LiN(C<sub>x</sub>F<sub>2x+1</sub>SO<sub>2</sub>)(C<sub>y</sub>F<sub>2y+1</sub>SO<sub>2</sub>) (wherein x and y are natural numbers), LiCl, and LiI.

28. The lithium secondary battery according to claim 22, wherein the electrolyte comprises non-aqueous organic solvent selected from the group consisting of a carbonate, an ester, an ether, and a ketone.

29. The lithium secondary battery according to claim 22, wherein the electrolyte further comprises an organic sulfone-based compound.

30. The lithium secondary battery according to claim 29, wherein the organic sulfone-based compound is represented by the following formula (8):



where  $\text{R}_{10}$  and  $\text{R}_{11}$  are independently selected from the group consisting of a primary alkyl group, a secondary alkyl group, a tertiary alkyl group, an alkenyl group, an cycloalkyl and aryl group, a C<sub>1</sub> to C<sub>4</sub> alkyl, a C<sub>2</sub> to C<sub>4</sub> alkenyl, a C<sub>3</sub> to C<sub>6</sub> cycloalkyl and a C<sub>6</sub> to C<sub>14</sub> aryl, or  $\text{R}_{10}$  and  $\text{R}_{11}$  are bound together to form a cyclic ring.

31. The lithium secondary battery according to claim 30, wherein either of  $\text{R}_{10}$  or  $\text{R}_{11}$  is substantially vinyl.

32. The lithium secondary battery according to claim 29, wherein the organic sulfone-based compound is used in an amount of 0.01 to 5 wt% based on a total weight of electrolyte.

33. The lithium secondary battery according to claim 22, wherein the lithium secondary battery includes a lithium ion battery or a lithium polymer battery.

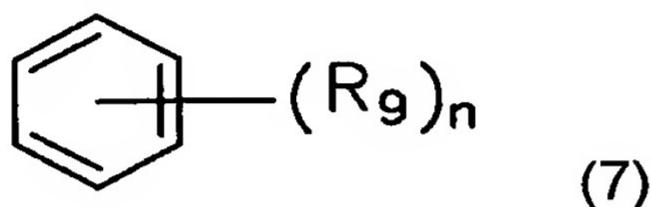
34. The lithium secondary battery according to claim 22, wherein the lithium secondary battery includes a non-aqueous electrolyte having a non-aqueous organic solvent that is at least one selected from the group consisting of a carbonate, an ester, an ether, and a ketone.

35. The lithium secondary battery according to claim 34, wherein the carbonate is selected from the group consisting of dimethyl carbonate (DMC), diethyl carbonate (DEC), dipropyl carbonate (DPC), methylpropyl carbonate (MPC), ethylpropyl carbonate (EPC), methylethyl carbonate (MEC), ethylene carbonate (EC), propylene carbonate (PC), and butylene carbonate (BC).

36. The lithium secondary battery according to claim 34, wherein the carbonate is a mixed solvent of a cyclic carbonate and a chain carbonate.

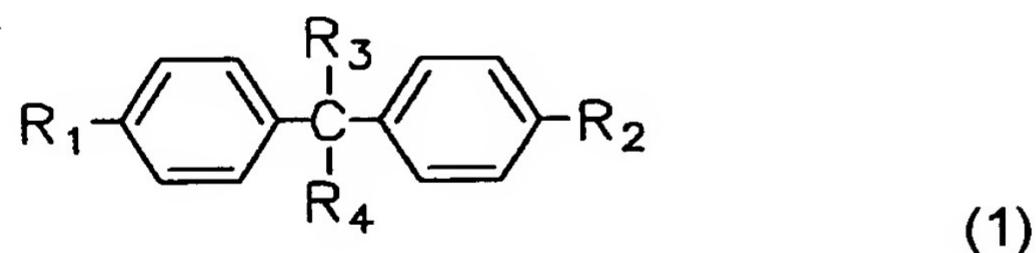
37. The lithium secondary battery according to claim 22, wherein the organic solvent comprises a mixed solvent of a carbonate solvent and an aromatic hydrocarbon solvent.

38. The lithium secondary battery according to claim 37, wherein the aromatic hydrocarbon solvent is a compound of Formula (7):

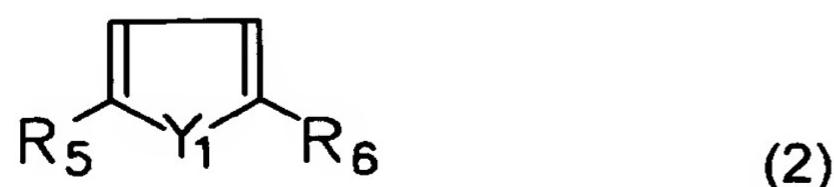


where R<sub>9</sub> is selected from a group consisting of a halogen, and a C<sub>1</sub> to C<sub>10</sub> alkyl, and n is an integer of 1 to 6.

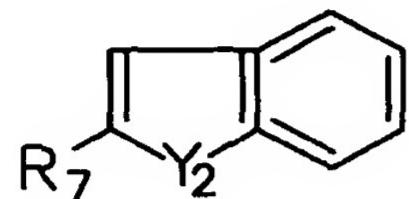
39. A non-aqueous electrolyte of a lithium secondary battery, comprising:  
a lithium salt;  
an organic solvent; and  
at least one additive compound selected from the group consisting of compounds represented by the following formulas (1) to (6):



where R<sub>1</sub> and R<sub>2</sub> are independently selected from the group consisting of a hydroxy, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy substituted with a halogen, a C<sub>1</sub> to C<sub>4</sub> alkyl, a C<sub>2</sub> to C<sub>4</sub> alkenyl, a C<sub>6</sub> to C<sub>14</sub> aryl, a C<sub>3</sub> to C<sub>6</sub> cycloalkyl, a C<sub>2</sub> to C<sub>6</sub> alkenyl substituted with a halogen, a halogen-substituted alkyl group, an alkenyl group, an aryl group, and a cycloalkyl group and R<sub>3</sub> and R<sub>4</sub> are independently selected from the group consisting of a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and a methyl;

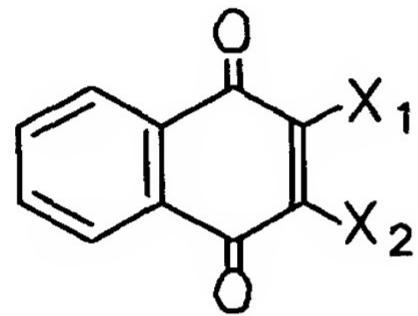


where  $Y_1$  is selected from the group consisting of O, NR (where R is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and 1-phenylsulfonyl), and S, and R<sub>5</sub> and R<sub>6</sub> are independently selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and an acetyl, and a methyl;



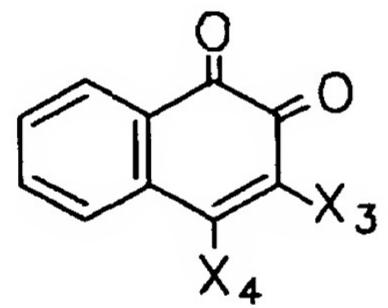
(3)

where Y<sub>2</sub> is selected from the group consisting of O, N, and S, and R<sub>7</sub> is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, and a C<sub>6</sub> to C<sub>12</sub> aryl;



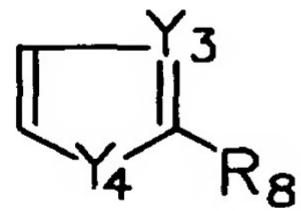
(4)

where X<sub>1</sub> and X<sub>2</sub> are independently selected from the group consisting of hydrogen and a halogen selected from the group consisting of F, Cl, and Br ;



(5)

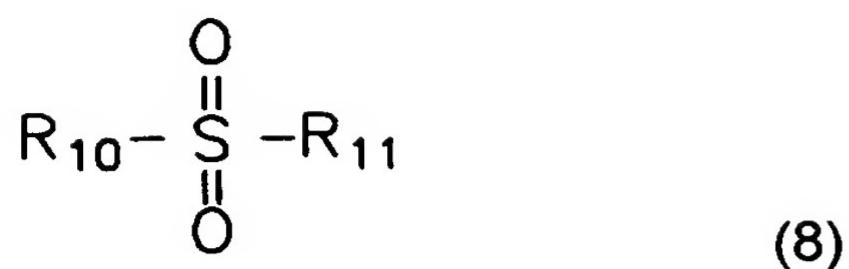
where X<sub>3</sub> and X<sub>4</sub> are independently selected from the group consisting of hydrogen and a halogen selected from the group consisting of F, Cl, and Br ; and



(6)

where Y<sub>3</sub> is selected from the group consisting of N, O, and S, and N, Y<sub>4</sub> is NR' (where R' is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, O, S, and NH, and R<sub>8</sub> is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and an acetyl; and

an organic sulfone-based compound that is represented by the following formula (8):



where  $\text{R}_{10}$  and  $\text{R}_{11}$  are independently selected from the group consisting of a primary alkyl group, a secondary alkyl group, a tertiary alkyl group, an alkenyl group, an cycloalkyl aryl group, a  $\text{C}_1$  to  $\text{C}_4$  alkyl, a  $\text{C}_2$  to  $\text{C}_4$  alkenyl, a  $\text{C}_3$  to  $\text{C}_6$  cycloalkyl and a  $\text{C}_6$  to  $\text{C}_{14}$  aryl, or  $\text{R}_{10}$  and  $\text{R}_{11}$  are bound together to form a cyclic ring.

40. The non-aqueous electrolyte of a lithium secondary battery according to claim 39, wherein either of  $\text{R}_{10}$  or  $\text{R}_{11}$  is substantially vinyl.

41. The non-aqueous electrolyte of a lithium secondary battery according to claim 39, wherein the carbonate solvent and the aromatic hydrocarbon solvent are mixed in a volume ratio of substantially 1:1 to 30:1.

42. The non-aqueous electrolyte of a lithium secondary battery according to claim 39, wherein  $\text{R}_1$  and  $\text{R}_2$  are independently selected from the group consisting of a  $\text{C}_1$  to  $\text{C}_4$  alkyl, a  $\text{C}_2$  to  $\text{C}_4$  alkenyl, a  $\text{C}_6$  to  $\text{C}_{14}$  aryl, and a  $\text{C}_3$  to  $\text{C}_6$  cycloalkyl.

43. The non-aqueous electrolyte of a lithium secondary battery according to claim 39, wherein  $\text{R}_1$  and  $\text{R}_2$  are independently selected from the group consisting of a halogen-substituted alkyl group, an alkenyl group, an aryl group, and a cycloalkyl group.

44. The non-aqueous electrolyte of a lithium secondary battery according to claim 39, wherein the organic sulfone-based compound is selected from the group consisting of vinyl sulfone, methyl sulfone, methylvinyl sulfone, ethylvinyl sulfone, phenyl sulfone, phenylvinyl sulfone, chlorophenylvinyl sulfone, fluorophenylvinyl sulfone, benzyl sulfone, tetramethylene sulfone, butadiene sulfone, and a mixture thereof.

45. A lithium secondary battery comprising:

a positive electrode including one of a material that reversibly intercalates/deintercalates lithium ions, and a material that reversibly forms a lithium-containing compound as a positive active material;

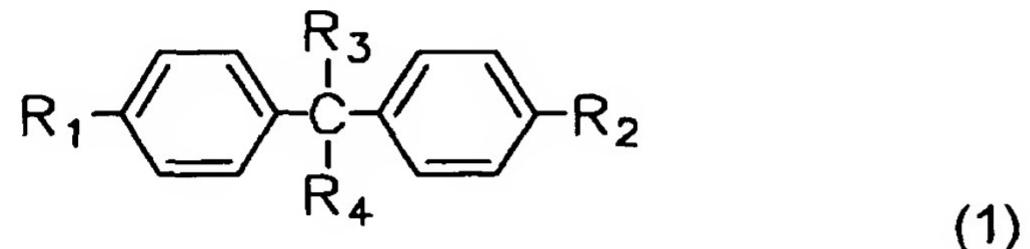
a negative electrode including one of a lithium metal, a lithium-containing alloy, and a material that reversibly intercalates/deintercalates the lithium ions; and

a non-aqueous electrolyte wherein the non-aqueous electrolyte comprises:

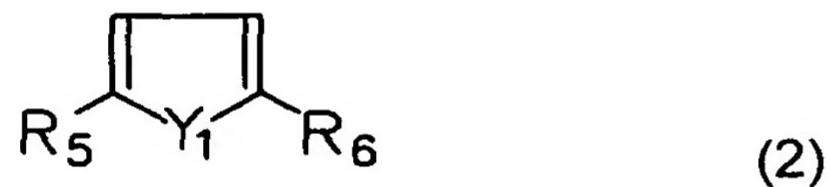
a lithium salt;

an organic solvent; and

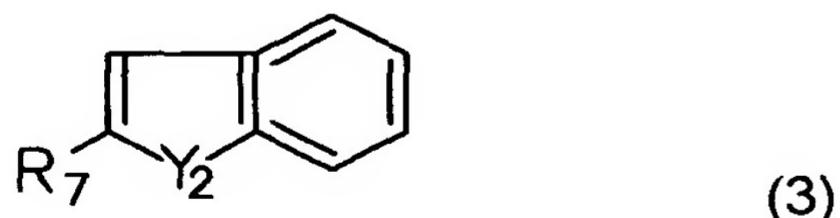
at least one additive compound selected from the group consisting of compounds represented by the following formulas (1) to (6):



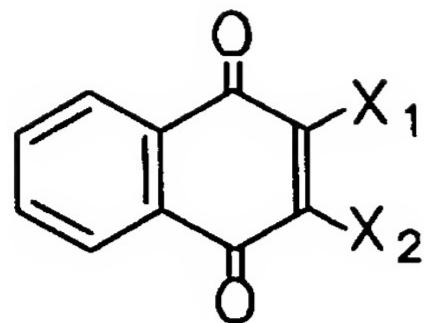
where R<sub>1</sub> and R<sub>2</sub> are independently selected from the group consisting of a hydroxy, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy substituted with a halogen, a C<sub>1</sub> to C<sub>4</sub> alkyl, a C<sub>2</sub> to C<sub>4</sub> alkenyl, a C<sub>6</sub> to C<sub>14</sub> aryl, and a C<sub>3</sub> to C<sub>6</sub> cycloalkyl, a halogen-substituted alkyl group, an alkenyl group, an aryl group, and a cycloalkyl group and a C<sub>2</sub> to C<sub>6</sub> alkenyl substituted with a halogen, and R<sub>3</sub> and R<sub>4</sub> are independently selected from the group consisting of a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and a methyl;



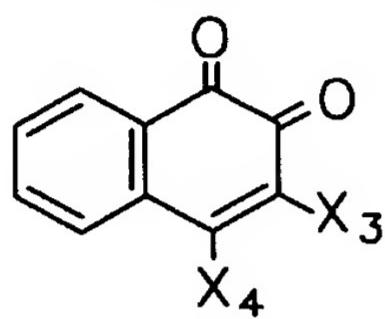
where Y<sub>1</sub> is selected from the group consisting of O, NR (where R is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>6</sub> to C<sub>12</sub> aryl, 1-phenylsulfonyl), and S, and R<sub>5</sub> and R<sub>6</sub> are independently selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>6</sub> to C<sub>12</sub> aryl, an acetyl, and a methyl;



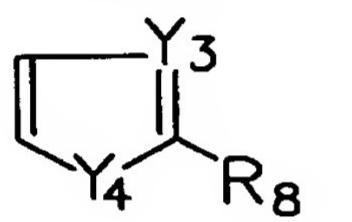
where Y<sub>2</sub> is selected from the group consisting of O, N, and S, and R<sub>7</sub> is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, and a C<sub>6</sub> to C<sub>12</sub> aryl;



where  $X_1$  and  $X_2$  are independently selected from the group consisting of hydrogen and a halogen selected from the group consisting of F, Cl, and Br ;



where  $X_3$  and  $X_4$  are independently selected from the group consisting of hydrogen and a halogen selected from the group consisting of F, Cl, and Br ; and



where  $Y_3$  is selected from the group consisting of N, O, and S,  $Y_4$  is NR' (where R' is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl), O, S, and NH, and  $R_8$  is selected from the group consisting of hydrogen, a C<sub>1</sub> to C<sub>6</sub> alkyl, a C<sub>1</sub> to C<sub>6</sub> alkoxy, a C<sub>2</sub> to C<sub>6</sub> alkenyl, a C<sub>6</sub> to C<sub>12</sub> aryl, and an acetyl; and

an organic sulfone-based compound that is represented by the following formula (8):



where  $R_{10}$  and  $R_{11}$  are independently selected from the group consisting of a primary alkyl group, a secondary alkyl group, a tertiary alkyl group, an alkenyl group, an cycloalkyl an aryl group, a C<sub>1</sub> to C<sub>4</sub> alkyl, a C<sub>2</sub> to C<sub>4</sub> alkenyl, a C<sub>3</sub> to C<sub>6</sub> cycloalkyl and a C<sub>6</sub> to C<sub>14</sub> aryl, or  $R_{10}$  and  $R_{11}$  are bound together to form a cyclic ring.

46. The lithium secondary battery according to claim 45, wherein either of  $R_{10}$  or  $R_{11}$  is substantially vinyl.

47. The lithium secondary battery according to claim 45, wherein R<sub>10</sub> and R<sub>11</sub> are independently selected from the group consisting of a halogen-substituted alkyl group, an alkenyl group, cycloalkyl group and an aryl group.

48. The lithium secondary battery according to claim 45, wherein the organic sulfone-based compound is selected from the group consisting of vinyl sulfone, methyl sulfone, methylvinyl sulfone, ethylvinyl sulfone, phenyl sulfone, phenylvinyl sulfone, chlorophenylvinyl sulfone, fluorophenylvinyl sulfone, benzyl sulfone, tetramethylene sulfone, butadiene sulfone, and a mixture thereof.